

Image-Guided Percutaneous Radiofrequency Ablation of Central Renal Cell Carcinoma: Assessment of Clinical Efficacy and Safety in 31 Tumors

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ABSTRACT

Purpose: To assess clinical efficacy and safety of image-guided percutaneous radiofrequency (RF) ablation of central renal cell carcinoma with adjunctive pyeloperfusion.

Materials and Methods: Patients with central renal tumors who underwent percutaneous RF ablation between 2005 and 2010 were retrospectively evaluated. Thirty patients with 31 central renal tumors underwent 39 RF ablation sessions. Mean tumor diameter was 3.7 cm (range, 2–7 cm). Median distance between tumor and renal pelvis was 5 mm (range, 0–15 mm). Pyeloperfusion was performed in 27 patients (27/30; 90%). Contrast-enhanced CT or MR imaging was performed to evaluate treatment response.

Results: Technical success of RF ablation was achieved in 38/39 (97.4%) ablation sessions. Primary efficacy was 83.9% (26/31) on first follow-up imaging. One (3.2%) case of local tumor progression was detected 6 months after initial ablation. Secondary efficacy was 96.8% (30/31) after repeat RF ablation for residual tumor or local tumor progression. Median follow-up was 88 months (mean 82.6 mo \pm 30.7; range, 9–121 mo). Major complications occurred in 5/39 (12.8%) RF ablation sessions. Complications were significantly higher for tumors located within 5 mm of the renal pelvis or 0 mm of a major calyx (28.6% vs 4.0%; $P < .05$). Overall survival was 96.0% (95% CI, 88.4%–100.0%), and progression-free survival at 5 years was 80.9% (95% CI, 65.8%–95.9%).

Conclusion: Image-guided percutaneous RF ablation combined with pyeloperfusion has satisfactory clinical efficacy in treating central renal tumors. Although clinically effective, RF ablation of central tumors may also be associated with significant major complications.

ABBREVIATIONS

RCC = renal cell carcinoma

Image-guided percutaneous radiofrequency (RF) ablation is a minimally invasive alternative to nephrectomy for selected patients with renal cell carcinoma (RCC) (1–4). Reported overall technical success rates of image-guided

percutaneous RF ablation are 89%–100% (5–9), with the highest rates associated with small (≤ 3 cm) exophytic or partially exophytic tumors (5). Centrally located tumors can be technically more challenging to treat with RF ablation owing to their proximity to the renal vasculature and central collecting system. Reported success rates of RF ablation for central tumors are 67%–78% (10,11). Retrograde pyeloperfusion may help protect the collecting system during RF ablation (12,13). The purpose of this study was to assess the clinical efficacy and safety of computed tomography (CT)-guided percutaneous RF ablation of central RCC with adjunctive pyeloperfusion.

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MATERIALS AND METHODS

This study received institutional review board approval, with waiver of informed consent, and was compliant with the Health Insurance Portability and Accountability Act. An

interventional radiology database was retrospectively reviewed to identify patients who underwent image-guided percutaneous RF ablation for biopsy-proven RCC. Imaging and clinical data were reviewed to identify patients treated for central renal tumors. Central tumors were defined as tumors that extended into the renal sinus. The distance from tumor to renal pelvis and/or a major calyx was measured on axial or coronal imaging at excretory phase.

Between December 2005 and October 2010, 347 patients with 387 RCCs underwent CT-guided percutaneous RF ablation. All ablations were performed with curative intent. Of these, 31 patients with 32 central tumors were identified. One patient with a solitary tumor was excluded from analysis owing to lack of contrast-enhanced imaging after RF ablation. The remaining 30 patients (male-to-female ratio = 19:11; mean age, 74.3 y; range, 55–89 y) with 31 tumors comprised the study group; 7 patients in the study cohort have been previously reported (13). Patient and tumor characteristics are listed in Tables 1 and 2 (14). Biopsy of all tumors was performed as a separate procedure from the RF ablation. Mean tumor diameter was 3.7 cm (range, 2–7 cm). The median distance between tumor and the pelvis was 5 mm (range, 0–15 mm). The median distance between tumor and a major calyx was 2 mm (range, 0–8 mm). Indications for RF ablation included high-risk surgical cases (n = 23), solitary kidney (n = 2), and patient preference (n = 5).

RF Ablation Technique

Moderate sedation was used in 28 patients (93.3%), and general anesthesia was used in 2 patients (6.7%). RF ablation was performed by 2 radiologists (R.S.A., R.U.) with 20 years and 15 years of experience in image-guided percutaneous RF ablation of renal masses. All ablations were performed using CT guidance (16-slice Lightspeed; GE Medical Systems, Madison, Wisconsin) with a 200-W generator and internally cooled electrode applicators (Cool-tip RF ablation system and switching controller; Medtronic, Minneapolis, Minnesota). Each ablation lasted 12 minutes, based on manufacturer recommendations. The

Table 1. Patient Characteristics

Characteristic	Value
Number of patients	30
Age, y, mean ± SD (range)	74.3 ± 9.3 (55–89)
Sex	
Male	19 (63.3)
Female	11 (36.7)
Comorbidities	
Impaired renal function	7 (23.3)
Contralateral nephrectomy	2 (6.7)
Cardiovascular and respiratory comorbidities	7 (23.3)
Extrarenal malignancy	11 (36.7)

Note—Values are presented as number (%) excepted where indicated.

Table 2. Tumor Characteristics

Characteristic	Value
Number of tumors	31
Size, cm, mean ± SD (range)	3.7 ± 1.3 (2–7)
≥ 3 cm	25 (80.6)
< 3 cm	6 (19.4)
Tumor side	
Right	14 (45.2)
Left	17 (54.8)
R.E.N.A.L. score complexity*	
Low (4–6)	0
Medium (7–9)	16 (51.6)
High (10–12)	15 (48.4)
Tumor polarity	
Mid (entirely between polar lines)	7 (22.6)
Upper (across or above upper polar line)	9 (29.0)
Lower (across or below lower polar line)	15 (48.4)
Exophytic/endophytic properties	
Entirely endophytic	13 (41.9)
< 50% exophytic	15 (48.4)
≥ 50% exophytic	3 (9.7)
Proximity of tumor to pelvis	
≥ 5 mm	20 (64.5)
< 5 mm	11 (35.5)
Proximity of tumor to major calyx	
0 mm	11 (35.5)
> 0 mm	20 (64.5)
Tumor histology	
Clear cell	21 (67.7)
Papillary	3 (9.7)
Chromophobe	5 (16.1)
No subtype	2 (6.4)

Note—Values are presented as number (%) excepted where indicated.

*Based on the R.E.N.A.L. nephrometry score (14).

mean total of overlapping ablations was 3.6 (range, 2–8). The number of overlapping ablations was based on tumor size and geometry with the intent to generate a zone of ablation that extended 5–10 mm into adjacent renal parenchyma. An unenhanced CT scan was obtained immediately after the procedure to evaluate for periprocedural complications.

Pyeloperfusion was performed in 27 of 30 (90%) patients. A 5-F ureteral stent (Pollack Open-End Flexi-Tip Ureteral Catheter; Cook Urological, Inc, Spencer, Indiana) was placed cystoscopically immediately before the procedure. The distal end of the ureteral stent was placed in the ipsilateral renal pelvis, and the proximal end was externalized through the meatus. The external end of the stent was attached to a 1-L bag of 5% dextrose in water via an intravenous set (ICU Medical, Inc, San Clemente, California), and the 5% dextrose in water drip infused at approximately 1 drop/s. The ureteral stent was removed immediately after the procedure. The 3 patients without

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